SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS (D2)
Small Launchers: Concepts and Operations (7)

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# RESPONSIVE, LOW-COST LAUNCH OF NANOSATELLITES AND TECHNOLOGY DEMONSTRATIONS

**Abstract**

Nanosatellites are emerging as key assets for a broad array of missions including space weather, communications, Earth observation and technology demonstrations for a wide variety of customers including the Department of Defense (DoD), NASA, the National Science Foundation (NSF), and universities. Currently, nanosatellites are launched as secondary payloads on large launch vehicles. While these launches are adequate for test demonstrations, the nanosat's orbital location is confined to the primary payload's orbital destination. More importantly, these launches are scheduled years in advance, requiring research to be placed on hold awaiting a launch – a particular problem for university faculty. In order to maximize the benefit of the next generation of nanosats, Dynetics recognizes that a dedicated, low cost, small payload launch system is needed to ensure rapid deployment and precise placement of nanosatellites and demonstration of advanced technologies such as advanced hypersonic systems, orbital systems, etc.

Dynetics, in support of the U.S. Army's Space and Missile Defense Command (SMDC), is currently developing the Multipurpose NanoMissile System (MNMS) to address these needs. Unlike past attempts in the arena of low cost, small launchers, the MNMS system is designed from the start to meet a low cost, responsive mission set. It is not simply a scaled down model of an expensive launch system. MNMS utilizes:

- Lowest cost materials (steel instead of aluminum)
- Pressure-fed propellants instead of turbopumps.
- Reliability  low part count over performance
- Modular assembly for "made to order" capability
- COTS wireless electronic component connectivity
- Rapid validation through extensive tests
- Safe fuel  oxidizer: ethane  nitrous oxide
- "Ship  shoot" approach
- Minimal range requirements

Through innovative, cost-driven, minimalist design, the MNMS team has applied lean, entrepreneurial practices to the challenges of space launch. The MNMS uses non-toxic liquid propellants that do not require cryogenic cooling below 0F. These propellants, which remain liquid at non-cryogenic temperature under their own significant vapor pressure, eliminate the needfor turbopumps or complex tank pressurization hardware. The self-pressurizing nitrous oxide and ethane propellants used for all three main stages

are storable, commonly available and easily handled. The rocket motor is submerged in the nitrous tank to reduce interstage mass and simplify propellant feeds for the motor and Liquid Injection Thrust Vector Control (LITVC). The use of propulsion modules with common components decreases the production costs of the MNMS...